WHAT IS CLAIMED IS:

1. A crystallization apparatus comprising: a phase shift mask; and an illumination system which illuminates the phase shift mask, the crystallization apparatus irradiating a polycrystal semiconductor film or an amorphous semiconductor film with a light ray having a light intensity distribution with an inverse peak pattern that a light intensity is minimum in an area corresponding to a phase shift portion of the phase shift mask, thereby generating a crystallized semiconductor film,

the crystallization apparatus further comprising an image forming optical system which has an image side numerical aperture set to a value required to generate the light intensity distribution with the inverse peak pattern and sets the polycrystal semiconductor film or the amorphous semiconductor film and the phase shift mask to an optically conjugate relationship,

the phase shift mask having a boundary area which extends along a first axial line, and a first area and a second area which are arranged on both sides of the boundary area along a second axial line intersecting with to the first axial line and have a predetermined phase difference therebetween, and

the boundary area having a phase distribution which varies from a phase of the first area to a phase of the second area along the second axial line.

2. The crystallization apparatus according to claim 1, wherein the boundary area has a phase distribution which continuously varies along the second axial line.

3. The crystallization apparatus according to claim 1, wherein the boundary area has a phase distribution which varies in a step form along the second axial line.

4. The crystallization apparatus according to claim 1, wherein the phase shift mask has a plurality of phase shift basic patterns, each consisting of the first area, the boundary area and the second area, the phase shift basic patterns being repeatedly formed along the second axial line.

5. The crystallization apparatus according to claim 4, wherein a small area having a predetermined shape is formed in the boundary area, and a second phase difference is given between the small area and a surrounding area of the small area.

6. The crystallization apparatus according to claim 5, wherein the small area is formed at a position corresponding to an area where a light intensity is minimum in the boundary area.

7. The crystallization apparatus according to claim 5, wherein the second phase difference is approximately 180 degrees.

8. The crystallization apparatus according to

claim 1, wherein the imaging forming optical system has a pupil function that a transmittance distribution is lower at the circumference than at the center.

9. The crystallization apparatus according to claim 8, wherein the imaging forming optical system has a pupil function that a transmittance distribution is of a Gauss type.

10. The crystallization apparatus according to claim 8, wherein a filter having a numerical aperture corresponding to the pupil function is arranged on a pupil plane of the image forming optical system or in the vicinity thereof.

11. The crystallization apparatus according to claim 5, wherein, assuming that NA is an image side numerical aperture of the image forming optical system, λ is a wavelength of the light and r is a radius of a circle circumscribing the small area, the following condition is satisfied:

$$0.05\lambda/NA \leqq r \leqq \lambda/NA$$

12. A crystallization method which illuminates a phase shift mask, and irradiates a polycrystal semiconductor film or an amorphous semiconductor film with a light ray having a light intensity distribution with an inverse peak pattern that a light intensity is minimum in an area corresponding to a phase shift portion of the phase shift mask, thereby generating a crystallized semiconductor film, comprising:

arranging an image forming optical system in a light path between the polycrystal semiconductor film or the amorphous semiconductor film and the phase shift mask;

setting an image side numerical aperture of the image forming optical system to a value required to generate the light intensity distribution with the inverse peak pattern;

setting the polycrystal semiconductor film or the amorphous semiconductor film to a position which is optically conjugate with the phase shift mask through the image forming optical system; and

using, as the phase shift mask, a phase shift mask which has a boundary area extending along a first axial line, and a first area and a second area which are arranged on both sides of the boundary area along a second axial line intersecting with the first axial line and have a predetermined phase difference therebetween, the boundary area having a phase distribution which varies from a phase of the first area to a phase of the second area along the second axial line.

13. A phase shift mask having a boundary area extending along a first axial line, and a first area and a second area which are arranged on both sides of the boundary area along a second axial line intersecting with the first axial line and have a

predetermined phase difference therebetween, the boundary area having a phase distribution which varies from a phase of the first area to a phase of the second area along the second axial line.

14. The phase shift mask according to claim 13, wherein a transparent substrate is provided, the boundary area and the first and second areas are formed on one surface of the substrate, and a plurality of steps are formed to the boundary area so as to be deep from the first area toward the second area.

15. The phase shift mask according to claim 13, wherein a small area having a predetermined shape is formed to a part of the boundary area, and a second phase difference is given between the small area and a surrounding area of the small area.

16. The phase shift mask according to claim 15, wherein the small area is formed by a protrusion or a dimple.

17. The phase shift mask according to claim 13, wherein the first axial line is orthogonal to the second axial line.

18. A filter which is arranged on a pupil plane of an image forming optical system or in the vicinity there of and defines a pupil function,

wherein the filter has a plurality of opening portions formed so as to correspond to the pupil function.